

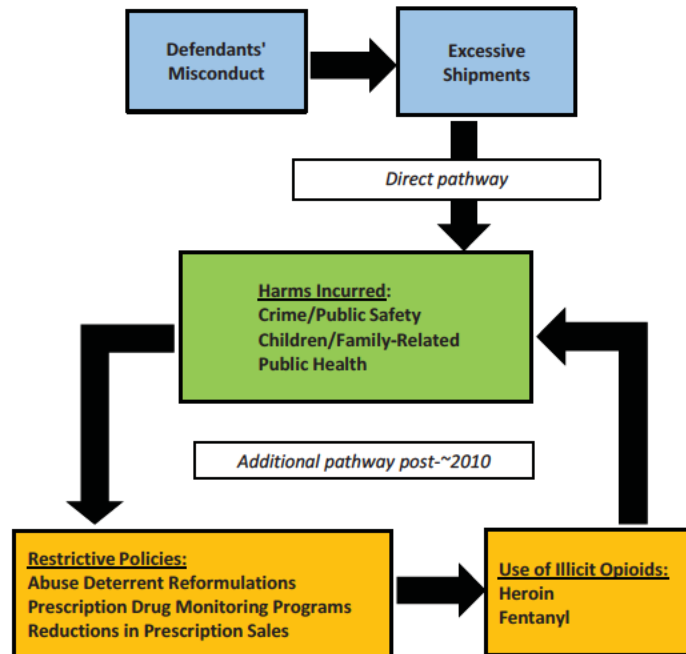
# **EXHIBIT 1**

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**Expert Report of Professor David Cutler**

**March 25, 2019**

**Figure III.1**  
**Relationship Between Opioid Sales and Harms**



19. The divisions in each of the Bellwether governments that have been affected by increased costs resulting from these harms are identified in the McGuire Report and are shown in **Table III.1** below, categorized based on the types of services these divisions provide to their jurisdictions.

20. For the purpose of evaluating opioid-related harms that impose costs on Bellwether governments, the analysis considers the impact of defendants' action on the following categories of harm: criminal activity that imposes costs on Bellwether divisions that provide police and public safety services; the demand for services related to children and families that imposes costs on Bellwether divisions responsible for children and family services; the demand for addiction treatment services funded by Bellwether governments; and the demand for services by medical examiners (coroners), which are also provided by Bellwether governments.

The framework of these applications is discussed in this section and the implementation and results of these calculations are presented in the following sections below.

**Table III.1**  
**Delineation of Services That are Affected by the Opioid Epidemic**

<b>Type of Harm</b>	<b>Counties (Cuyahoga/Summit)</b>
Crime/Public Safety	Sheriff Juvenile and County courts Prosecutor and Public Defenders' Office Corrections
Children/Family Related	Children and Family Services / Children Services Board
Public Health	Alcohol/Drug/Mental Health Boards Medical Examiners' Office

#### **A. Overview of General Framework**

21. This section describes and motivates the general framework used to estimate harms caused by opioid shipments that result from defendants' misconduct. This framework requires three component calculations:

- The percentage of harms that is attributable to opioids;
- The percentage of opioid-related harms that is attributable to shipments of prescription opioids; and
- The percentage of shipment-related harms that is attributable to defendants' misconduct.

22. This general framework is applied in evaluating each of the harms that have imposed costs on selected divisions of the Bellwether governments. Together, these components yield estimates of the share of various harms that are attributable to shipments resulting from defendants' misconduct.

section describes the key elements of the calculations and the data that underlies these calculations for each of the harms that impose costs on the Bellwether governments.

33. As noted, for most harms, the calculation of the share that is attributable to opioids itself involves two distinct steps: (i) estimation of the percent of harms due to drug use as a whole and (ii) estimation of the percent of drug activity due to opioids. These two components are then multiplied to yield an estimate of the share of harms that are attributable to opioids. A brief description of these calculations is presented below for each of the different categories of harm. The full details of the data and calculations are presented in the **Appendices III.C through III.G** attached to this report.

#### **A. Share of Crime Attributable to Opioids**

34. The share of criminal activity attributed to opioids is used to estimate opioid-related costs across Bellwether divisions with responsibilities that include policing, courts and adjudication, and corrections. Therefore, while the general estimation method is the same across these divisions (or types of activities), the data used in the calculation can vary by division and Bellwether depending on activity and data availability. Descriptions of the methodology and data used are provided below, including discussions of differences, when relevant, across divisions and Bellwether governments.<sup>16</sup>

35. To measure the share of crime due to opioids, data are utilized on criminal activity for each Bellwether and crime-related division.<sup>17</sup> These data provide information on the total

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<sup>16</sup> As referenced above, this methodology (and many of the data sources used in the estimation) follow the literature of Florence, et al. (2016), Birnbaum et al. (2011), and Birnbaum et al. (2006).

<sup>17</sup> Criminal activity is measured as crime offenses, criminal bookings, or criminal charges depending on the data source listed in Table III.2.

amount of criminal activity as well as the distribution of the type of crime (e.g. murder, burglary, motor vehicle theft, etc.) across the relevant crime measure. **Table III.2** below reports the source of data for each of the Bellwether divisions for these crime counts.

**Table III.2**  
**Sources of Crime Incident Data by Bellwether and Division**

Bellwether	Division	Source of Crime Incident Counts
Cuyahoga	Prosecutor / Public Defender / Court of Common Pleas / Sheriff / Jail / Juvenile Court	Cuyahoga Prosecutor Database (2009 - 2017)
Summit	Prosecutor / Court of Common Pleas / Sheriff / Adult Probation / Juvenile Court	NIBRS
	Sheriff Jail / Alternative Corrections	Bureau of Justice Statistics - Prisoner Statistics

36. The FBI's National Incident-Based Reporting System (NIBRS) data provide information on the number and type of criminal offenses that occurred within the jurisdiction of the Sheriff division in Summit County.<sup>18</sup> These data are used to estimate criminal activity for the Sheriff division that provides policing services as well as for divisions that provide court and adjudication services in Summit, as this kind of data for these other divisions were not available (as indicated in **Table III.2** above). Because NIBRS data are not available for Cuyahoga County, the estimates for criminal activity in Cuyahoga's divisions are calculated from data provided by the Cuyahoga County Prosecutors Office on criminal charges. These data provide the number of criminal charges, the FBI Uniform Crime Reporting category for each of these charges, and an indication as to whether or not the charged individual was a juvenile.

37. For the Summit County correctional services, the measure of criminal activity is derived from Bureau of Justice Statistics data on the distribution of crime across inmates in the Ohio

<sup>18</sup> <https://ucr.fbi.gov/nibrs-overview>.

state prison system. Finally, estimates for the juvenile court divisions in both Summit and Cuyahoga rely on data reporting the distribution of criminal activity in that area, as well as data on child removals (discussed in more detail below in Section IV.C), as these courts handle both criminal cases involving juveniles, as well as cases involving children removed from homes.

38. Using the data described above, the next step in the analysis is to then determine the share of these crimes that were either directly or indirectly motivated by drugs. This calculation relies on the reported percentages of different crime categories that are committed for drug-related reasons, as estimated in a study published by the National Drug Intelligence Center (NDIC) of the U.S. Department of Justice in 2011.<sup>19</sup> These estimates, which are based on interviews of prisoners, attempt to identify the circumstances surrounding arrests. Drug crimes are defined to include those involving the purchase or sale of illicit drugs as well as estimates of the share of other crimes undertaken to obtain drugs or to obtain money to purchase drugs. NDIC also counts a small portion of crimes undertaken while on drugs as drug-related.<sup>20</sup> The specific shares of crimes due to drug use are shown in **Table III.3** below. These drug-related shares are applied to the crime counts in each of the Bellwethers in each year to calculate a share of total crime in each year that is drug-related.<sup>21</sup>

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<sup>19</sup> US DOJ National Drug Intelligence Center, "The Economic Impact of Illicit Drug Use on American Society" (2011) (NDIC (2011)), Table 1.7.

<sup>20</sup> NDIC counts only 10 percent of crimes committed under the influence of drugs as "drug crimes," assuming that 90 percent of such crimes also would have been undertaken in the absence of drugs. NDIC recognizes that this estimate may be conservative. If so, this approach conservatively underestimates drug crimes. (NDIC (2011), p. 8)

<sup>21</sup> The most recent NDIC estimate (published in 2011) uses survey data from 2002. Therefore, it is assumed that these percentages have not changed and thus are applied in every year of the calculation.

**Table III.3**  
**Share of Crimes that are Drug Related**

<b>Crime Category</b>	<b>Percent of Crimes that are Drug-Related</b>
Aggravated Assault	4.4%
All Other Offenses	7.0%
Arson	1.3%
Burglary	32.3%
Curfew/Loitering/Vagrancy	N/A
Disorderly Conduct	N/A
Driving Under the Influence	3.5%
Drug Crimes	100.0%
Drunkenness	8.3%
Embezzlement	8.8%
Family and Children	5.1%
Forcible Rape	5.5%
Forgery and Fraud	32.2%
Gambling Offenses	N/A
Human Trafficking	N/A
Larceny-theft	28.8%
Liquor Laws	0.0%
Motor Vehicle Theft	24.1%
Murder	3.9%
Other Assaults	4.4%
Prostitution	51.1%
Robbery	29.5%
Sex Offenses	0.9%
Stolen Property	12.2%
Vandalism	2.8%
Weapons	3.0%

Source: Appendix III.C 3, Panel A.

39. Not all drug-related crimes are due to opioids. To estimate the share of these drug-related crimes that are opioid-related, two sources that measure the prevalence of opioid use are utilized. First, the share of crimes reported as drug crimes that are attributed to opioids is estimated using annual data on the share of drugs seized and tested by forensic laboratories in drug crime investigations reported by the National Forensic Laboratory Information System (NFLIS).<sup>22</sup> The opioid share of reported drug crimes is calculated using the share of such tests undertaken by forensic laboratories in Ohio in which an opioid was detected. In 2017, this share was 36.6%. To estimate the share of other “drug-related” crimes (other types of reported

<sup>22</sup> <https://www.nflis.deaddiversion.usdoj.gov/reports.aspx>.



crimes that are attributed as drug-related as described above) that are attributable to opioids, annual data on the share of individuals with Substance Use Disorders (SUD) in Ohio that have Opioid Use Disorder (OUD), as reported by the National Survey on Drug Use and Health (NSDUH) are utilized.<sup>23</sup> Using these two sources of information on the opioid contribution to drug-related activities, the percentage of drug-related crimes that are due to opioids is calculated.

40. This method is applied to all divisions in the Bellwether governments that provide services related to crime, which include policing, courts and adjudication, and corrections.

**Table III.4** below reports the resulting opioid-related percentages for these different divisions.<sup>24</sup>

The calculations underlying the data presented in this table are available in **Appendix III.C**.

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<sup>23</sup> Because the NSDUH definition of OUD changed after 2014 (and state-level responses are not available for 2014), this value from this calculation is held constant from 2013 onward. The actual percentages implied by the reported 2015 through 2017 data from NSDUH do not differ much from this assumption. I further understand that other experts discuss additional limitations regarding NSDUH data.

<sup>24</sup> **Table III.4** does not report the opioid-related percentages for the Juvenile Court divisions for either Summit or Cuyahoga as these calculations incorporate estimates on the extent of opioid-related activity for county divisions services provided to children and families, which are discussed below. Therefore, the Juvenile Court percentages are presented in Section IV.D after reviewing this calculation.

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**Table III.4**  
**Opioid-Related Percent of Criminal Activity**

Bellwether	Division	Metric	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cuyahoga	Prosecutor	[1] Drug-Related % of Charges	34.0%	33.7%	33.3%	32.9%	32.8%	32.4%	32.6%	32.0%	28.6%	25.1%	25.9%	30.0%
	Public Defender	[2] Opioid % of Drug Charges	16.3%	16.3%	21.5%	25.5%	29.2%	29.9%	30.2%	31.4%	32.8%	34.8%	35.0%	36.6%
	Sheriff	[3] <b>Opioid-Related % of Charges</b>	<b>5.5%</b>	<b>5.5%</b>	<b>7.2%</b>	<b>8.4%</b>	<b>9.6%</b>	<b>9.7%</b>	<b>9.8%</b>	<b>10.1%</b>	<b>9.4%</b>	<b>8.7%</b>	<b>9.1%</b>	<b>11.0%</b>
	Court of Common Pleas Jail	[4] Drug-Related % of Adult Charges	35.1%	34.7%	34.3%	33.9%	33.8%	33.7%	34.5%	34.7%	32.1%	27.9%	28.7%	33.3%
		[5] Opioid % of Drug Adult Charges	16.1%	16.1%	21.3%	25.4%	29.2%	29.8%	30.0%	31.2%	32.5%	34.6%	34.9%	36.6%
		[6] <b>Opioid-Related % of Adult Charges</b>	<b>5.7%</b>	<b>5.6%</b>	<b>7.3%</b>	<b>8.6%</b>	<b>9.9%</b>	<b>10.1%</b>	<b>10.3%</b>	<b>10.8%</b>	<b>10.4%</b>	<b>9.7%</b>	<b>10.0%</b>	<b>12.2%</b>
Summit	Prosecutor	[7] Drug-Related % of Crimes	28.3%	25.6%	24.9%	29.2%	25.5%	29.0%	29.5%	27.8%	29.6%	32.8%	33.6%	32.3%
	Court of Common Pleas	[8] Opioid % of Drug Crimes	19.1%	19.7%	26.4%	27.5%	31.0%	31.0%	32.0%	33.2%	33.7%	35.0%	35.2%	36.6%
	Sheriff	[9] <b>Opioid-Related % of Crimes</b>	<b>5.4%</b>	<b>5.0%</b>	<b>6.6%</b>	<b>8.0%</b>	<b>7.9%</b>	<b>9.0%</b>	<b>9.5%</b>	<b>9.2%</b>	<b>10.0%</b>	<b>11.5%</b>	<b>11.8%</b>	<b>11.8%</b>
	Adult Probation													
	Sheriff Jail	[10] Drug-Related % of Prisoners	32.1%	32.0%	30.6%	29.9%	29.2%	28.6%	27.9%	27.9%	27.6%	26.9%	26.9%	26.9%
	Alternative Corrections	[11] Opioid % of Drug Prisoners	17.1%	17.0%	22.5%	26.2%	29.8%	30.3%	31.1%	32.2%	33.1%	34.8%	34.8%	34.8%
		[12] <b>Opioid-Related % of Prisoners</b>	<b>5.5%</b>	<b>5.4%</b>	<b>6.9%</b>	<b>7.8%</b>	<b>8.7%</b>	<b>8.7%</b>	<b>8.7%</b>	<b>9.0%</b>	<b>9.1%</b>	<b>9.4%</b>	<b>9.4%</b>	<b>9.4%</b>

[1] Appendix III.C.1, Panel A[3]

[2] Appendix III.C.1, Panel A[6]

[3] [1]\*[2]

[4] Appendix III.C.1, Panel B[3]

[5] Appendix III.C.1, Panel B[6]

[6] [4]\*[5]

[7] Appendix III.C.2, Panel A[3]

[8] Appendix III.C.2, Panel A[6]

[9] [7]\*[8]

[10] Appendix III.C.2, Panel B[3]

[11] Appendix III.C.2, Panel B[6]

[12] [10]\*[11]

**B. Share of Addiction and Mental Health Activity Attributable to Opioids**

41. The opioid crisis has resulted in increased costs faced by the Bellwether governments related to the funding of treatment for abuse and related services. These services are provided through the Alcohol, Drug Addiction, and Mental Health Services (ADAMHS) Board of Cuyahoga County and the Alcohol, Drug and Mental Health (ADM) Board of Summit County. These are quasi-independent boards that contract with provider agencies to provide mental health, addiction treatment and recovery services to the county residents.<sup>25</sup> These boards are funded in part by their respective counties.<sup>26</sup> To estimate the harms (costs of treatment and addiction services that are provided through these boards) due to opioids, the percentage of the Cuyahoga and Summit County contributions to their respective ADAMHS/ADM boards that were used for opioid-related services was estimated.

42. There are two elements of this calculation: (i) determination of the portion of board expenditures that are associated with addiction services, and (ii) determination of the portion of individuals receiving addiction services for opioids (for Cuyahoga) or the share of addiction expenditures used for OUD (for Summit).<sup>27</sup> These figures are identified in the ADAMHS and ADM boards' annual reports. It is then assumed that the share of Cuyahoga/Summit County contributions to their respective ADAMHS/ADM boards that is used for opioid-related services are equal to the percentage of these organizations' budgets that is used for providing opioid-

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<sup>25</sup> See <http://adamhsc.org/> and <https://www.admboard.org/admboard-history.aspx> for a description of these services.

<sup>26</sup> See McGuire Report, Appendices IV.C and IV.D for details on the counties' annual contribution to their respective boards.

<sup>27</sup> This element was calculated using different metrics across the two counties due to difference in data reported by Cuyahoga and Summit counties.

related services. The results of this analysis are summarized in **Table III.5** below and the calculations underlying these results are reported in detail in **Appendix III.D**.

**Table III.5**  
**Opioid-Related Percent of Treatment and Addiction Services**

Division / Metric	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
<b>Cuyahoga ADAMHS Board:</b>												
[1] Addiction-Related % of Spending	23.9%	23.9%	23.8%	20.1%	19.3%	18.7%	18.7%	26.0%	23.5%	26.5%	27.1%	29.4%
[2] Opioid-Related % of Indiv. Treated	13.7%	16.2%	18.7%	21.2%	22.3%	22.1%	21.9%	26.7%	30.5%	33.2%	45.1%	47.5%
[3] Opioid-Related % of Services	3.3%	3.9%	4.4%	4.3%	4.3%	4.1%	4.1%	6.9%	7.2%	8.8%	12.2%	14.0%
<b>Summit ADM Board:</b>												
[4] Addiction-Related % of Spending	24.9%	24.2%	22.0%	20.5%	17.0%	16.8%	22.4%	31.2%	33.5%	33.6%	32.3%	32.4%
[5] Opioid-Related % of Addiction Spending	6.8%	8.0%	10.2%	13.9%	34.5%	33.3%	36.5%	38.7%	37.8%	39.2%	47.5%	42.4%
[6] Opioid-Related % of Spending	1.7%	1.9%	2.2%	2.8%	5.9%	5.6%	8.2%	12.1%	12.7%	13.2%	15.3%	13.7%
[1] Appendix III.D.1, Panel A[4]												
[2] Appendix III.D.1, Panel A[8]												
[3] [1]*[2]												
[4] Appendix III.D.2, Panel A[6]												
[5] Appendix III.D.2, Panel A[9]												
[6] [4]*[5]												

### C. Share of Children's and Family Services Due to Opioids

43. The opioid crisis has resulted in increased demand for the provision of services to children and families.<sup>28</sup> Such services are provided by the Department of Children's and Family Services in Cuyahoga and Summit counties. These services support children of adults that misuse opioids, by either providing in-home support or removing the children and placing them in foster care.<sup>29</sup>

<sup>28</sup> Summit County Children Services 2016 Annual Report, p. 2 ("As a result of the explosion of substance abuse involved cases, especially from the recent opioid epidemic, the increased number of children who entered custody has had a dramatic impact on the agency's operating budget.") Deposition of Cynthia Weiskittel, Director of Children and Family Services Cuyahoga County, November 13, 2018, p. 35 ("I can say that our caseloads are up and that is due in part to the opioid situation"). See also, Adrienne DiPiazza, "Opioid crisis leaves more children needing foster care in Cuyahoga County," *Fox 8 Cleveland*, May 1, 2018, available at <https://fox8.com/2018/05/01/opioid-crisis-leaves-more-children-needing-foster-care-in-cuyahoga-county/>.

<sup>29</sup> Summit County Children Services 2016 Annual Report; Cuyahoga County Department of Health and Human Services, 2016 Annual Report, p. 9.

44. The share of foster care services attributable to opioids in the two Bellwether counties is based on a December 2017 publication by the Public Children Services Association of Ohio titled “The Opioid Epidemic’s Impact on Children Services in Ohio.”<sup>30</sup> This study reports the percentage of children taken into custody in 2015 in Summit and Cuyahoga counties that had parents who were using opioids at the time of removal. This percentage is then backcasted for 2006 through 2014 and forecasted for 2016 through 2017 under the assumption that opioid-related child removals track the trend in the annual changes of OUD treatment expenses in the counties. This is measured using the percentage of individuals receiving ADAMHS addiction services for opioids (for Cuyahoga) and in the percentage of addiction expenditures that are opioid-related (for Summit). These results are presented in **Table III.6** below for the two Bellwether counties and the calculations underlying these results are reported in detail in **Appendix III.E**.

**Table III.6**  
**Opioid-Related Percent of Child Removals**

Division / Metric	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
<b>Cuyahoga Children and Family Services:</b>												
[1] Opioid-Related % of Removals	4.5%	5.4%	6.2%	7.0%	7.4%	7.3%	7.2%	8.8%	10.1%	11.0%	14.9%	15.7%
<b>Summit Children Services Board:</b>												
[2] Opioid-Related % of Removals	4.4%	5.1%	6.5%	8.8%	22.0%	21.2%	23.3%	24.7%	24.1%	25.0%	30.3%	27.0%
[1] = Appendix III.E.1, Panel A[1]												
[2] = Appendix III.E.2, Panel A[1]												

<sup>30</sup> The Public Children Services Association of Ohio (PCSAO) is an “association of Ohio’s county Public Children Services Agencies that advocates for and promotes child protection program excellence and sound public policy for safe children, stable families, and supportive communities.” (<http://www.pcsao.org/who-we-are>). The PCSAO study titled “The Opioid Epidemic’s Impact on Children Services in Ohio” was published in December 2017 based on survey responses from 78 Public Children Services Agencies.

#### **D. Share of Juvenile Court Activity Attributable to Opioids**

45. As discussed above, the juvenile courts handle both criminal cases involving juveniles as well as child removals, both of which are affected by the opioid crisis. As such, the percentage of harms attributable to opioids for this division in Summit and Cuyahoga counties is calculated as sum of the percent of harms from criminal activity attributable to opioids and the percent of child removals that are attributable to opioids. This is calculated using data from Cuyahoga and Summit on the number and nature of the juvenile charges and cases that appeared in the juvenile courts over the time period. To calculate opioid-related juvenile cases related to juvenile criminal activity, the analysis starts first with the category of criminal charges reported for all 'Delinquency and Unruly' cases. The percent of these charges that are opioid-related is calculated using the same method and data as described above for criminal activity. Namely the percent of juvenile criminal charges that is drug-related is estimated using the DOJ study and the percent of these drug-related charges that are opioid-related are estimated using the DEA and NSDUH data.<sup>31</sup> The percent of charges that are opioid-related is then applied to the total number of these cases to arrive at an estimate of opioid-related criminal cases.<sup>32</sup> To estimate the number of opioid-related removal cases in the juvenile court, the percentage of opioid-related child removals (calculated in **Table III.6**) is applied to the number of 'Abuse, Dependency, Neglect' cases in the relevant year. The sum of these two calculations, as a percentage of total juvenile cases, provides an estimate of the percent of opioid-related case

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<sup>31</sup> Data on the type of criminal charge for Summit Juvenile Charges is only available for 2014 through 2016. The remaining years are estimated by trending these values (back to 2006 and forward to 2017) based on the trend exhibited by Summit's opioid-related percent of criminal activity estimated in Table III.4.

<sup>32</sup> Note that a single case in the juvenile system can be associated with multiple charges.

activity in these courts and, thus, an estimate of the percentage of harms or costs incurred by the juvenile court system that are attributable to the opioid epidemic from an increase in both crime and child removals. **Table III.7** below reports these results. Detailed calculations underlying these results are available in **Appendix III.F**.

**Table III.7**  
**Opioid-Related Percent of Juvenile Court Activity**

Division / Metric	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
<b>Cuyahoga Juvenile Court:</b>												
[1] Opioid-Related % of Juvenile Cases	1.6%	1.7%	2.4%	2.3%	2.4%	2.5%	2.3%	2.8%	3.3%	3.2%	4.3%	4.3%
<b>Summit Juvenile Court:</b>												
[2] Opioid-Related % of Juvenile Cases	2.6%	2.7%	3.4%	4.0%	4.4%	4.9%	5.3%	4.9%	5.3%	5.6%	6.8%	6.5%

[1] Appendix III.F.1, Panel A[11]

[2] Appendix III.F.2, Panel A[11]

#### **E. Opioid Related Share of Medical Examiner Activity**

46. The opioid crisis has resulted in increased costs by the Medical Examiner offices in both Cuyahoga and Summit counties as a result of the need to respond to the increase in opioid fatalities that lead to required autopsies. The share of activities undertaken by the Medical Examiner that are opioid-related is estimated using data on the share of in-county autopsies that are found to be opioid-related. This is calculated based on death records maintained by county officials, which identify whether opioids (of any type) were identified within the deceased.<sup>33</sup> **Table III.8** reports these estimates. The calculations underlying these estimates are available in **Appendix III.G**.

<sup>33</sup> Summit County and Cuyahoga County Medical Examiners' offices also perform autopsies for deaths that occurred outside of their respective county. These are excluded from the calculation.

**Table III.8**  
**Opioid-Related Percent of Medical Examiner Autopsies**

Division / Metric	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
<b>Cuyahoga Medical Examiner:</b>												
[1] Opioid-Related % of Autopsies	9.1%	8.5%	12.0%	14.8%	17.1%	21.3%	21.5%	24.8%	24.4%	23.4%	37.9%	38.4%
<b>Summit Medical Examiner:</b>												
[2] Opioid-Related % of Autopsies	10.9%	10.5%	9.5%	13.3%	15.5%	12.6%	17.6%	15.5%	23.3%	27.0%	37.0%	31.9%
[1] = Appendix III.G.1, Panel A[3]												
[2] = Appendix III.G.2., Panel A[3]												

## **V. Estimation of the Relationship Between Shipments and Opioid-Related Mortality**

47. The above section estimates the share of various harms faced by the Bellwether governments that are related to opioids for select divisions. However, because these jurisdictions would have faced some opioid-related costs even in the absence of the increasing availability of prescription opioids due to the defendants' misconduct, it is necessary to estimate the share of opioid-related harms that are attributable to shipments of prescription opioids. Data on opioid-related mortality provide the most comprehensive information available for identifying the impact of shipments on harms and these data are used to develop an estimate of the share of opioid-related harms attributable to shipments of prescription opioids for all the divisions. Mortality data also provide a useful measure of opioid-related harms because of the direct connection between availability of legal and illegal opioids and opioid-related deaths. Unlike crime or foster care placements, which are harms that one would expect would exist at some level even without opioids, there is no reason to expect there would be opioid-related deaths in the absence of supplies of prescription opioids and illegal substitutes.



dependence on opioids, or the addiction risk and the potential for abuse of illicit opioids.

Furthermore, as also concluded by Professor Gruber, the increase in the demand for illicit opioids, and the associated increases in mortality, would not have occurred in the absence of the enormous increase in prescription opioid shipments resulting from defendants' misconduct, which effectively created a stock of individuals susceptible to illicit opioid use and abuse.

54. The combined consequence of these factors was a rapid growth in misuse of illicit opioids and increase in mortality due to heroin and fentanyl which began around 2010. The increase in deaths due to illicit opioid use far exceeded the decline in mortality associated with prescription opioids and thus, as a result, total mortality rose even as legal opioid shipments fell.

55. In short, the nature of the opioid crisis changed around 2010. This resulted in a shift in the relationship between shipments of prescription opioids and mortality that has been widely recognized in the economic literature.<sup>37</sup> Here, the shift reflects the dramatic increase in heroin-related mortality post-2010, which is confirmed by statistical analysis of changes in trends in heroin-related overdose mortality from 1999-2014. (The analysis is limited to this period given that the emergence of fentanyl resulted in further acceleration in deaths due to illicit opioid use around 2014).

56. To capture this shift in the relationship between shipments and mortality, a statistical analysis identified the month that best identifies the date at which the time series of heroin

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<sup>37</sup> For example, see: Evans, et al (2019); Alpert, Abby, David Powell, and Rosalie Liccardo Pacula. "Supply-Side Drug Policy In The Presence Of Substitutes: Evidence From The Introduction Of Abuse-Deterrent Opioids." *American Economic Journal: Economic Policy* 10 (2018): 1-35.

mortality rates shifted, both with respect to the level and trend in the rate. The month with the highest likelihood of a shift (as measured by the largest F-statistic from a joint test of the equality of the slope and intercepts before and after the break point) was identified.<sup>38</sup>

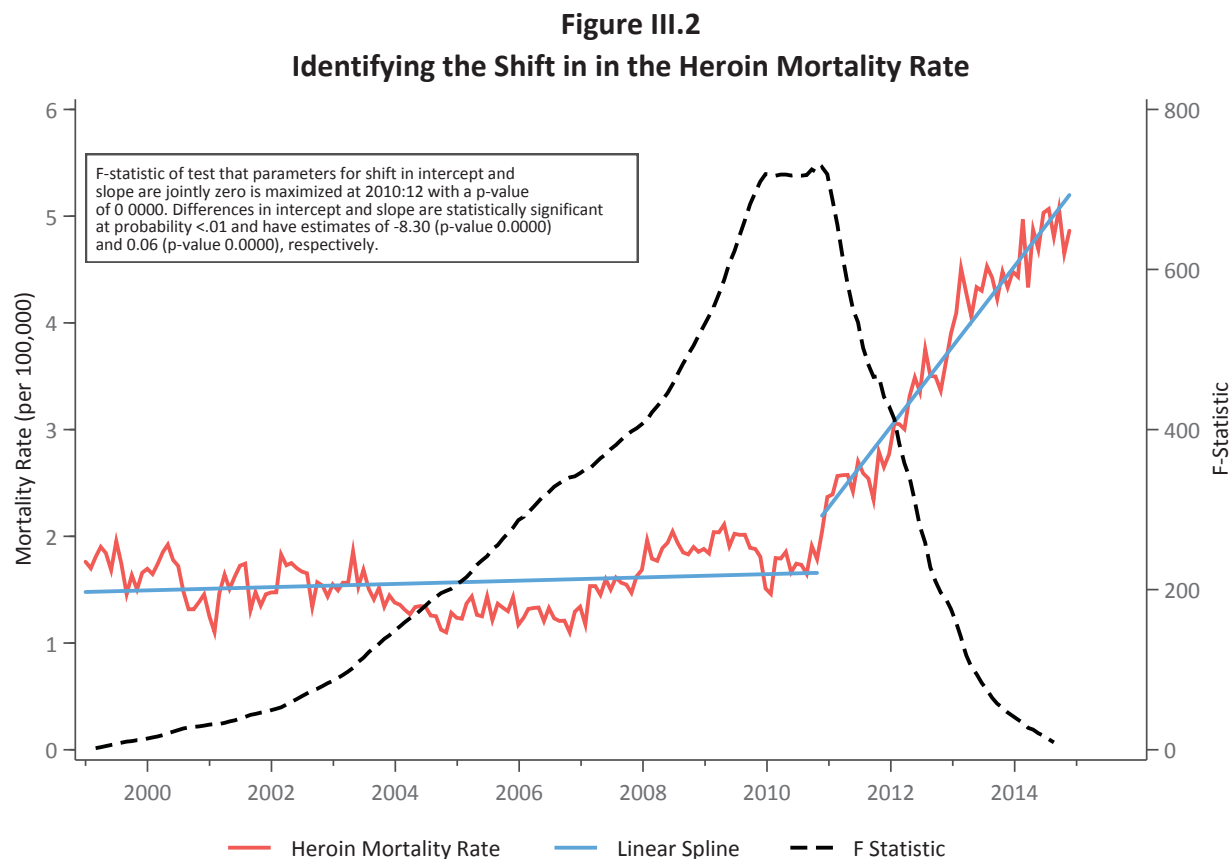
57. **Figure III.2** below reports the heroin mortality rates and the regression estimate of the trends before and after the best estimate of the date of the shift in this rate. The analysis confirms that: (i) the change in heroin-related opioid mortality trends after 2010 is (highly) statistically significant, with both a discrete jump in the rate of heroin mortality and a change in the trend in heroin mortality over time; and (ii) that the best estimate of the date of the shift in this rate was in late 2010, shortly after the start of the decline in prescription opioid shipments.<sup>39</sup>

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<sup>38</sup> See Chow, Gregory C. "Tests of equality between sets of coefficients in two linear regressions." *Econometrica: Journal of the Econometric Society* 28 (1960): 591-605; Quandt, Richard E. "Tests of the hypothesis that a linear regression system obeys two separate regimes." *Journal of the American statistical Association* 55 (1960): 324-330; Fisher, Franklin M. "Tests of equality between sets of coefficients in two linear regressions: An expository note." *Econometrica: Journal of the Econometric Society* 28 (1970): 361-366; An F-statistic is used in econometrics to test whether the values across two groups differ from each other. The largest F-statistic identifies the month associated with the largest difference in the trends (growth rates) of heroin mortality between the two periods.

<sup>39</sup> Evans et al. (2019) present a similar analysis and reach a similar conclusion.

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Source: NCHS Mortality Data

58. Consistent with the events described above, mortality associated with prescription opioids (not involving illicit opioids) also started to decline around the same time as the acceleration of illicit opioid deaths. A similar analysis establishes that the long-term trend of increasing prescription opioid mortality was reversed around the same time and that the best estimate of this shift was December 2010. **Figure III.3** reports the prescription opioid mortality rates and the regression estimate of the trends before and after the best estimate of the date of the shift in the rate.

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**Table III.12**  
**Percent of Deaths Due to Illicit Opioid Use Attributable to Defendants' Misconduct**  
**Based on Indirect Regression**  
**2011-2016**

Year	Illicit (Heroin + Fentanyl)								
	Actual Mortality	Predicted Mortality Relative to 2010	Predicted Mortality	Difference Between Actual and Predicted Mortality	Incremental Difference Over 2010	Weighted Average Cumulative Percent of Shipments Attributable to Defendants' Misconduct	Impact on Mortality	But-For Mortality	Percent Impact on Mortality
	A	B	$C = C_{2010} * B$	$D = A - C$	$E = D - D_{2010}$	F	$G = D_{2010} + (E * F)$	$H = A - G$	$I = G / A$
2010	3.14	100.0%	2.33	0.81	0.00	47.5%	0.81	2.33	25.9%
2011	3.80	94.3%	2.19	1.60	0.79	48.3%	1.20	2.60	31.5%
2012	4.55	85.5%	1.99	2.56	1.75	49.1%	1.67	2.88	36.7%
2013	5.65	79.3%	1.84	3.81	2.99	49.8%	2.30	3.35	40.8%
2014	7.28	70.8%	1.65	5.63	4.82	50.6%	3.25	4.03	44.6%
2015	9.22	64.4%	1.50	7.72	6.91	51.3%	4.36	4.86	47.3%
2016	12.20	60.4%	1.40	10.80	9.98	51.9%	6.00	6.20	49.1%

Notes: Column B calculated based on predicted values from indirect regression. Impact in 2010 (0.81) reported in Column G is calculated based on (i) actual illicit mortality in 2010 (3.14) reported in Column A and (ii) percent impact for 2010 reported in Table III.10 and Column I (25.9%):  $0.81 = 3.14 * .259$ . Impact for 2011-2016 calculated by applying the incremental difference between actual and predicted mortality above 2010 levels in Column E by the weighted average cumulative percent of shipments attributable to defendants' misconduct in Column F.

## 5. Percent of Harms Attributable to Defendants' Misconduct under Approach 1

115. **Table III.13** combines the results of estimated but-for opioid mortality from the direct analysis for 1997-2010 with the results of but-for mortality from the analyses regarding deaths due to licit and illicit opioids for 2011-2016, yielding year-specific estimates of but-for opioid mortality and the percentage of opioid mortality that is attributable to defendants' misconduct. The results indicate that the share of opioid mortality attributable to such misconduct grew from roughly 21 percent in 2006 to more than 47 percent by 2016.

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**Table III.13**  
**Percent of Harms Attributable to Defendants' Misconduct Under Approach 1**  
**2006 – 2016**

Year	Any Opioid			Licit (Rx + Methadone)			Illicit (Heroin + Fentanyl)			Total			
	Actual Mortality	Impact on Mortality	But-For Mortality	Actual Mortality	Impact on Mortality	But-For Mortality	Actual Mortality	Impact on Mortality	But-For Mortality	Actual Mortality	Impact on Mortality	But-For Mortality	Percent Impact
	A	B	C = A - B	D	E	F = D - E	G	H	I = G - H	J	K	L = J - K	M = K / J
2006	9.97	2.10	7.87							9.97	2.10	7.87	21.1%
2007	10.51	2.34	8.17							10.51	2.34	8.17	22.3%
2008	11.06	2.57	8.49							11.06	2.57	8.49	23.3%
2009	11.45	2.79	8.66							11.45	2.79	8.66	24.4%
2010	11.66	3.02	8.64							11.66	3.02	8.64	25.9%
2011				8.23	2.17	6.07	3.80	1.20	2.60	12.03	3.36	8.67	27.9%
2012				7.47	2.29	5.18	4.55	1.67	2.88	12.02	3.96	8.06	33.0%
2013				6.92	2.40	4.52	5.65	2.30	3.35	12.57	4.70	7.87	37.4%
2014				6.57	2.49	4.07	7.28	3.25	4.03	13.85	5.74	8.10	41.5%
2015				6.05	2.58	3.47	9.22	4.36	4.86	15.27	6.93	8.34	45.4%
2016				5.91	2.64	3.27	12.20	6.00	6.20	18.11	8.63	9.47	47.7%

## B. Approach 2

116. Approach 2 calculates the share of opioid mortality due to defendants' shipments attributable to misconduct based on the indirect regression model that estimates the relationship between opioid mortality and the economic and demographic characteristics of counties over the 1993-95 time period. This analysis is based on the period before the launch of OxyContin and the subsequent acceleration in the growth of prescription opioid shipments, and thus yields estimates of opioid-related mortality rates that would have been expected to prevail in the absence of these events. Recognizing that the direct model yields only a lower bound estimate of the impact of shipments of prescription opioids on opioid-related mortality, application of the indirect approach based on the 1993-95 benchmark reflects the view that increases in opioid mortality not attributable to changes in economic and demographic factors can be attributed to the growth in shipments of prescription opioids.

117. The application of these results to estimate the share of opioid mortality attributable to defendants' misconduct is analogous to the application of the indirect model for illicit mortality

## **Appendix III.J: Framework for Estimating Harms Due to Distributor Misconduct**

1. As the Bellwether plaintiffs have alleged, the opioid epidemic and the need for increased services, “arose from the opioid manufacturers’ deliberately deceptive marketing strategy to expand opioid use, together with the distributors’ equally deliberate efforts to evade restrictions on opioid distribution.”<sup>1</sup> While the defendants’ misleading marketing contributed to the opioid epidemic, “the crisis was fueled and sustained by those involved in the supply chain of opioids, including manufacturers, distributors, and pharmacies . . . who failed to maintain effective controls over the distribution of prescription opioids, and who instead have actively sought to evade such controls . . . thereby exacerbating the oversupply of such drugs and fueling an illegal secondary market.”<sup>2</sup>

2. Tables III.13 and III.14 report the share of harms due to defendants’ misconduct that are based on estimates of the share of prescription opioid shipments attributable to misleading marketing reported by Prof. Rosenthal. While this estimate may reflect the harm that could have been avoided in the absence of marketing misconduct, some portion of the harm resulting from such shipments also could have been avoided had CSA registrants, such as defendant distributors, not acted improperly. I understand that all CSA registrants such as distributors of prescription opioids have legal obligations to monitor, identify and report shipments to regulatory authorities that may be unrelated to medical need and to prevent such shipments. The alleged failure to carry out these responsibilities thus contributed to the explosion of prescription opioid shipments that contributed to the opioid crisis documented by Prof. Gruber.

3. The estimates of the share of harms due to defendants’ misconduct for Cuyahoga and Summit Counties reported in Tables III.16A-B do not attempt to uniquely attribute harm resulting from actions by any individual type of defendant. This does not reflect a problem with the underlying data or analysis but instead is the result of the fact that multiple parties are responsible for harms. For example, assume

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<sup>1</sup> Cuyahoga Complaint, ¶13; Summit Complaint ¶3.

<sup>2</sup> Cuyahoga Complaint, ¶14; Summit Complaint, ¶14.

that 80% of harm can be attributed to manufacturer misconduct and 70% of that harm could have been avoided if distributors had acted properly. As an economic matter, manufacturers are appropriately held liable for at least the 10% of the harm that distributors could not have avoided. However, as discussed in the report, there is no unique or economically “correct” allocation of liability for the 70% of harm that could have avoided if each party had it met its legal obligations. Note that it is not necessarily the case that harm due to misconduct by CSA registrants is a subset of harm due to misleading marketing. Even in the absence of improper marketing, the failure of distributors and other CSA registrants to identify suspicious and excessive shipments can result in harm.

4. Nonetheless, the share of harm for which distributors can potentially be said to be liable can be estimated based on a variant of the framework used in Section VII. Specifically, the share of harm potentially attributable to distributors can be calculated by applying an estimate of the *share of excessive shipments that distributors failed to identify* (to the extent such a measure is available) instead of the estimate of the *share of shipments due to misleading marketing misconduct* in the Section VII framework. More specifically, the share of harm attributable to distributor misconduct can be measured as:

$$\begin{aligned}
 & \text{Share of Harms Attributable to } \mathbf{Distributor} \text{ Misconduct} \\
 &= \text{Share of Harms Attributable to Opioids} \\
 &\quad \times \text{Share of Opioid Harms Attributable to Opioid Shipments} \\
 &\quad \times \text{Share of Opioid Shipments Due to } \mathbf{Distributor} \text{ Misconduct}
 \end{aligned}$$

5. That is, modifying the Section VII framework to address distributor misconduct requires only a modification of the last input, the “*Share of Opioid Shipments Due to Distributor Misconduct*,” as the other two inputs are not specific to the attribution across the conduct of the multiple parties. This appendix presents an example of how this analysis can be applied if appropriate data become available



to estimate the share of prescription opioid shipments that reflect distributor misconduct. This example can be readily updated when appropriate estimates become available.

6. Table J.1 reports the data on the share of shipments for which the distributors are liable that have been provided to me by counsel and that I understand will be set forth in reports disclosed on April 15, 2019.

**Table J.1: Percent of Shipments Attributable to Distributors' Misconduct**

Year	Percent of Shipments Attributable to
	Distributors' Misconduct
1997	49.9%
1998	67.0%
1999	64.4%
2000	64.7%
2001	63.0%
2002	59.8%
2003	67.3%
2004	64.5%
2005	72.2%
2006	73.1%
2007	76.4%
2008	78.4%
2009	78.7%
2010	79.2%
2011	80.0%
2012	82.5%
2013	81.7%
2014	82.7%
2015	83.4%
2016	83.5%

These shares provide estimates of shipments of prescription opioids that would have been avoided in the absence of distributors' misconduct and can be used to estimate average shipments but-for distributor misconduct. Incorporating these estimates into the Approach 1 and Approach 2 analyses

(discussed in Section VI) then yields an estimate of the share of harms attributable to distributors' misconduct. Specifically, the calculation yields estimate of the product of the "*Share of Opioid Harms Attributable to Opioid Shipments*" and "*Share of Opioid Shipments Due to Distributor Misconduct*" in the equation above. Tables J.2 and J.3 below present these results.

**Table J.2: Percent of Harms Attributable to Distributors' Misconduct Under Approach 1  
2006 – 2016**

Year	Any Opioid			Licit (Rx + Methadone)			Illicit (Heroin + Fentanyl)			Total			
	Actual Mortality	Impact on Mortality	But-For Mortality	Actual Mortality	Impact on Mortality	But-For Mortality	Actual Mortality	Impact on Mortality	But-For Mortality	Actual Mortality	Impact on Mortality	But-For Mortality	Percent Impact
	A	B	C = A - B	D	E	F = D - E	G	H	I = G - H	J	K	L = J - K	M = K / J
2006	9.97	3.25	6.72							9.97	3.25	6.72	32.6%
2007	10.51	3.59	6.92							10.51	3.59	6.92	34.2%
2008	11.06	3.92	7.14							11.06	3.92	7.14	35.4%
2009	11.45	4.23	7.22							11.45	4.23	7.22	37.0%
2010	11.66	4.56	7.10							11.66	4.56	7.10	39.1%
2011				8.23	3.27	4.97	3.80	1.78	2.01	12.03	5.05	6.98	42.0%
2012				7.47	3.45	4.02	4.55	2.47	2.08	12.02	5.92	6.11	49.2%
2013				6.92	3.59	3.33	5.65	3.39	2.26	12.57	6.98	5.59	55.5%
2014				6.57	3.71	2.86	7.28	4.75	2.53	13.85	8.46	5.39	61.1%
2015				6.05	3.80	2.24	9.22	6.34	2.89	15.27	10.14	5.13	66.4%
2016				5.91	3.87	2.04	12.20	8.69	3.51	18.11	12.56	5.54	69.4%

**Table J.3: Percent of Harms Attributable to Distributors' Misconduct Under Approach 2  
2006 – 2016**

Year	Actual Mortality	Predicted Mortality	Percent Impact of All Shipments	Weighted Average Cumulative Percent of Shipments Attributable to Defendants' Misconduct		Percent Impact
	A	B	$C = (A - B) / A$	D	$E = C * D$	
2006	8.46	1.38	83.7%	66.3%	55.5%	
2007	9.13	1.31	85.6%	67.9%	58.1%	
2008	9.83	1.45	85.2%	69.4%	59.1%	
2009	9.69	2.22	77.1%	70.6%	54.4%	
2010	10.23	2.27	77.8%	71.7%	55.7%	
2011	11.44	2.04	82.2%	72.6%	59.7%	
2012	11.62	1.85	84.1%	73.6%	61.9%	
2013	12.31	1.73	85.9%	74.3%	63.8%	
2014	13.75	1.51	89.0%	75.0%	66.7%	
2015	15.39	1.38	91.1%	75.5%	68.8%	
2016	18.46	1.33	92.8%	76.0%	70.6%	

7. The final step in the estimation is to combine these estimates with the “Share of Harm Attributable to Opioids” for the divisions identified in Cuyahoga and Summit counties, as described in Section IV. Tables J.4 and J.5 below report these results.

**Table J.4: Share of Cuyahoga Opioid Harms Due to Distributors’ Misconduct**

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>Approach 1</b>													
ADAMHS Board	1.1%	1.3%	1.6%	1.6%	1.7%	1.7%	2.0%	3.9%	4.4%	5.8%	8.5%	9.7%	9.7%
DCFS	1.5%	1.8%	2.2%	2.6%	2.9%	3.1%	3.6%	4.9%	6.2%	7.3%	10.4%	10.9%	10.9%
Office of Prosecutor	1.8%	1.9%	2.5%	3.1%	3.8%	4.1%	4.8%	5.6%	5.7%	5.8%	6.3%	7.6%	7.6%
Office of Public Defender	1.8%	1.9%	2.5%	3.1%	3.8%	4.1%	4.8%	5.6%	5.7%	5.8%	6.3%	7.6%	7.6%
Court of Common Pleas	1.8%	1.9%	2.6%	3.2%	3.9%	4.2%	5.1%	6.0%	6.4%	6.4%	6.9%	8.4%	8.4%
Juvenile Court	0.5%	0.6%	0.8%	0.9%	0.9%	1.0%	1.1%	1.5%	2.0%	2.1%	3.0%	3.0%	3.0%
Sheriff's Office	1.8%	1.9%	2.5%	3.1%	3.8%	4.1%	4.8%	5.6%	5.7%	5.8%	6.3%	7.6%	7.6%
County Jail	1.8%	1.9%	2.5%	3.1%	3.8%	4.1%	4.8%	5.6%	5.7%	5.8%	6.3%	7.6%	7.6%
Office of Medical Examiner	3.0%	2.9%	4.3%	5.5%	6.7%	8.9%	10.6%	13.8%	14.9%	15.6%	26.3%	26.6%	26.6%
<b>Approach 2</b>													
ADAMHS Board	1.8%	2.2%	2.6%	2.3%	2.4%	2.5%	2.5%	4.4%	4.8%	6.1%	8.6%	9.8%	9.8%
DCFS	2.5%	3.1%	3.7%	3.8%	4.1%	4.4%	4.5%	5.6%	6.7%	7.6%	10.5%	11.1%	11.1%
Office of Prosecutor	3.1%	3.2%	4.2%	4.6%	5.3%	5.8%	6.1%	6.4%	6.3%	6.0%	6.4%	7.7%	7.7%
Office of Public Defender	3.1%	3.2%	4.2%	4.6%	5.3%	5.8%	6.1%	6.4%	6.3%	6.0%	6.4%	7.7%	7.7%
Court of Common Pleas	3.1%	3.3%	4.3%	4.7%	5.5%	6.0%	6.4%	6.9%	7.0%	6.6%	7.1%	8.6%	8.6%
Juvenile Court	0.9%	1.0%	1.4%	1.3%	1.3%	1.5%	1.4%	1.8%	2.2%	2.2%	3.1%	3.1%	3.1%
Sheriff's Office	3.1%	3.2%	4.2%	4.6%	5.3%	5.8%	6.1%	6.4%	6.3%	6.0%	6.4%	7.7%	7.7%
County Jail	3.1%	3.2%	4.2%	4.6%	5.3%	5.8%	6.1%	6.4%	6.3%	6.0%	6.4%	7.7%	7.7%
Office of Medical Examiner	5.0%	4.9%	7.1%	8.1%	9.5%	12.7%	13.3%	15.8%	16.3%	16.1%	26.8%	27.1%	27.1%

**Table J.5: Share of Summit Opioid Harms Due to Distributors’ Misconduct**

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>Approach 1</b>													
ADM Board	0.6%	0.7%	0.8%	1.0%	2.3%	2.3%	4.0%	6.7%	7.7%	8.7%	10.6%	9.5%	9.5%
Children Services Board	1.4%	1.7%	2.3%	3.3%	8.6%	8.9%	11.5%	13.7%	14.7%	16.6%	21.0%	18.7%	18.7%
Prosecutor	1.8%	1.7%	2.3%	3.0%	3.1%	3.8%	4.7%	5.1%	6.1%	7.6%	8.2%	8.2%	8.2%
Court of Common Pleas	1.8%	1.7%	2.3%	3.0%	3.1%	3.8%	4.7%	5.1%	6.1%	7.6%	8.2%	8.2%	8.2%
Juvenile Court	0.9%	0.9%	1.2%	1.5%	1.7%	2.1%	2.6%	2.7%	3.2%	3.7%	4.7%	4.5%	4.5%
Sheriff's Office	1.8%	1.7%	2.3%	3.0%	3.1%	3.8%	4.7%	5.1%	6.1%	7.6%	8.2%	8.2%	8.2%
County Jail	1.8%	1.9%	2.4%	2.9%	3.4%	3.6%	4.3%	5.0%	5.6%	6.2%	6.5%	6.5%	6.5%
Alternative Corrections	1.8%	1.9%	2.4%	2.9%	3.4%	3.6%	4.3%	5.0%	5.6%	6.2%	6.5%	6.5%	6.5%
Adult Probation	1.8%	1.7%	2.3%	3.0%	3.1%	3.8%	4.7%	5.1%	6.1%	7.6%	8.2%	8.2%	8.2%
Medical Examiner	3.6%	3.6%	3.4%	4.9%	6.1%	5.3%	8.7%	8.6%	14.2%	17.9%	25.7%	22.1%	22.1%
<b>Approach 2</b>													
ADM Board	0.9%	1.1%	1.3%	1.5%	3.3%	3.3%	5.1%	7.7%	8.4%	9.1%	10.8%	9.7%	9.7%
Children Services Board	2.4%	3.0%	3.8%	4.8%	12.3%	12.7%	14.4%	15.7%	16.1%	17.2%	21.4%	19.1%	19.1%
Prosecutor	3.0%	2.9%	3.9%	4.4%	4.4%	5.4%	5.9%	5.9%	6.7%	7.9%	8.3%	8.3%	8.3%
Court of Common Pleas	3.0%	2.9%	3.9%	4.4%	4.4%	5.4%	5.9%	5.9%	6.7%	7.9%	8.3%	8.3%	8.3%
Juvenile Court	1.5%	1.6%	2.0%	2.2%	2.5%	2.9%	3.3%	3.1%	3.5%	3.9%	4.8%	4.6%	4.6%
Sheriff's Office	3.0%	2.9%	3.9%	4.4%	4.4%	5.4%	5.9%	5.9%	6.7%	7.9%	8.3%	8.3%	8.3%
County Jail	3.0%	3.2%	4.1%	4.3%	4.8%	5.2%	5.4%	5.7%	6.1%	6.4%	6.6%	6.6%	6.6%
Alternative Corrections	3.0%	3.2%	4.1%	4.3%	4.8%	5.2%	5.4%	5.7%	6.1%	6.4%	6.6%	6.6%	6.6%
Adult Probation	3.0%	2.9%	3.9%	4.4%	4.4%	5.4%	5.9%	5.9%	6.7%	7.9%	8.3%	8.3%	8.3%
Medical Examiner	6.1%	6.1%	5.6%	7.3%	8.6%	7.5%	10.9%	9.9%	15.5%	18.5%	26.1%	22.5%	22.5%

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March 25, 2019

A handwritten signature in black ink, appearing to read "David M. Cutler". The signature is written in a cursive, slightly slanted style.

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David Cutler